

REMARKS/ARGUMENTS

Claims 1-3, 5, 7-8 and 10-11 are pending herein. The PTO has withdrawn claims 5 and 7 from further consideration. Claims 1 and 8 have been amended as supported at paragraph [0029] in the specification, for example. Claims 12 and 13 have been cancelled without prejudice or disclaimer. Applicants respectfully submit that no new matter has been added.

Examiner Turocy is thanked for courtesies extended to Applicants' undersigned representative during a telephonic interview on April 1, 2010. During the interview, Examiner Turocy confirmed that an RCE would be required to enter the claim amendments, which require further search and/or consideration by the Examiner. Accordingly, an RCE is filed herewith.

1. Claims 1-3, 8 and 10-13 were rejected under §112, first paragraph. This rejection is respectfully traversed.

With respect to the "not a crystalline diamond like carbon" claim limitation, Applicants respectfully submit that this limitation is supported at paragraphs [0002]-[0003] and [0030]-[0031] in the specification, which describe a main peak wave number for diamond like carbon film at approximately 1580 cm^{-1} and a shoulder peak wave number of approximately $1300\text{-}1500\text{ cm}^{-1}$. These values are significantly different from the value reported in Yara (a main peak wave number of 1332 cm^{-1}), and quantitatively demonstrate to one skilled in the art the differences in physical characteristics between the claimed non-crystalline diamond like carbon and the

crystalline diamond like carbon produced by Yara. One of skill in the art would understand that the diamond like carbon produced by the present invention is not crystalline diamond like carbon based on the quantitative values recited in the claims and the distinct values disclosed in Yara.

With respect to the “opposing electrodes are not covered with a solid dielectric material” claim limitation, Applicants respectfully submit that this limitation is supported by Fig. 2 which shows electrodes 4 and 5 are not covered with a dielectric material. This claim limitation is further supported by the Examples described in the specification. This claim limitation is further supported by the attached Rule 1.132 Declaration of Dr. Takao Saito which includes experimental data demonstrating that covering an electrode with a dielectric material (e.g., glass) prevents arc discharge from occurring but does not allow for the formation of the diamond like carbon on the substrate (Declaration, paragraph 8).

For at least the foregoing reasons, Applicants respectfully submit that all of the claim limitations are supported in the specification. Accordingly, Applicants respectfully request that the Examiner reconsider and withdraw this rejection.

2. The rejection of claims 12 and 13 under §112, second paragraph is noted, but deemed moot in view of the cancellation of claims 12 and 13 in the amended claim set submitted above.

3. Claims 1-3 and 10 were rejected under §103(a) over Yara alone or in view of Hartmann or Awazu; and claims 1-3, 8 and 10-13 were rejected under §103(a) over Yara in view of Mizuno. To the extent that these rejections may be applied against the amended claims, they are respectfully traversed.

Claim 1 has been amended to clarify that the pulse voltage is applied on the opposing electrodes under a pressure of 100-1600 Torr in an atmosphere consisting of a carbon source gas and helium gas to generate discharge plasma so a thin film, comprising diamond like carbon that is not crystalline diamond like carbon, is formed on a substrate. Independent claim 8 has been amended in a similar manner.

Yara discloses a method for producing thin carbon films at a low temperature by setting a solid dielectric along an opposing plane of counter electrodes and creating a plasma by applying a pulse electric field between the counter electrodes in an atmosphere containing carbon and oxygen and/or hydrogen under a pressure near atmospheric pressure. The PTO relies upon Hartmann and Awazu for disclosing diamond like carbon thin films having a Raman spectrum allegedly near the claimed wave numbers. The PTO relies upon Mizuno for allegedly disclosing an ultra short pulse to charge plasma for forming diamond like carbon thin films under low or vacuum pressure conditions.

Amended independent claims 1 and 8 are distinguishable from the cited references for at least the following reasons.

First, the cited references fail to teach or suggest a method for producing diamond like carbon using helium gas as the dilution gas. More specifically, Yara

discloses using nitrogen gas and acetylene gas (or ethyl alcohol) to produce a crystalline diamond like carbon film (paragraphs [0051] and [0053]). In contrast, amended claims 1 and 8 now clearly recite applying a pulse voltage on the opposing electrodes under a pressure of 100-1600 Torr in an atmosphere consisting of a carbon gas and helium gas to generate the discharge plasma. Hartmann, which discloses a methane and hydrogen gas mixture, Awazu, which discloses an argon and nitrogen gas mixture, and Mizuno, which discloses a methane hydrogen gas mixture and argon gas, fail to overcome the deficiencies of Yara.

The effect of using helium as the dilution gas, compared to nitrogen gas as disclosed in Yara, is demonstrated by the attached Rule 1.132 Declaration of Dr. Saito. The Declaration shows that using nitrogen gas in place of helium gas resulted in an arc discharge that created a plasma that was too unstable to form a deposited film (Declaration, paragraph 7). Thus, the claimed atmosphere is distinct from the cited references.

Second, the diamond like carbon formed by the cited references is crystalline diamond like carbon and does not have the Raman spectrum comprising a main peak at about a wave number of 1580 cm^{-1} and a shoulder peak in the wave number range of 1300 cm^{-1} to 1500 cm^{-1} , as claimed. More specifically, the PTO admits that Yara discloses the diamond like carbon film having a Raman spectrum peak at 1332 cm^{-1} and fails to disclose the claimed main peak and shoulder peak (Office Action at page 6). To overcome this deficiency, the PTO cites to Hartmann and Awazu for allegedly

disclosing the claimed main peak at about 1580 cm^{-1} and the claimed shoulder peak in the range of 1300 cm^{-1} to 1500 cm^{-1} .

However, the PTO mischaracterizes Hartmann as disclosing that the diamond like carbon Raman spectrum is adjusted by varying the gas phase concentrations, citing page 854 of Hartmann (Office Action at page 7). In accordance with all of the examples of Hartmann, using a rectangular DC voltage in different methane concentrations, the Raman spectrum includes a main peak attributable to the crystalline diamond like carbon at $1310\text{-}1360\text{ cm}^{-1}$ and twin peaks attributed to amorphous carbon at 1475 and 1548 cm^{-1} - - there is no disclosure of any other phase. As shown in Figs. 4a and 4b of Hartmann, all of the main peaks of the crystalline diamond like carbon film are between $1310\text{-}1350\text{ cm}^{-1}$ for all of the disclosed methane concentrations. The non-diamond like carbon peak is attributed to amorphous carbon having twin peaks at 1475 cm^{-1} and 1548 cm^{-1} (page 854, right column, lines 25-30). The amorphous carbon is a non-diamond like carbon material and the twin peaks at 1475 and 1548 cm^{-1} are a characteristic of amorphous carbon. Diamond like carbon does not exhibit a twin peak characteristic. Thus, Hartmann simply discloses a crystalline diamond like carbon main peak at $1310\text{-}1360\text{ cm}^{-1}$ and twin peaks at 1475 and 1548 cm^{-1} that are attributable to amorphous carbon and are not a main peak of the diamond like carbon.

Awazu discloses diamond like carbon films formed by a hybrid pulse plasma coating system in which the Raman spectrum has a main peak around 1590 cm^{-1} and is not substantially changed when the gas concentrations are varied.

Mizuno fails to overcome the deficiencies of Yara, Hartmann and Awazu.

In contrast, amended claims 1 and 8 clearly recite that the diamond like carbon thin film is not a crystalline diamond like carbon and has a Raman spectrum comprising a main peak at about a wave number of 1580 cm^{-1} and a shoulder peak in a wave number range of 1300 cm^{-1} to 1500 cm^{-1} . Thus, the claimed diamond like carbon thin film resulting from the claimed method is distinct from the diamond like carbon formed by the cited references.

Third, the cited references specifically disclose that at least one of the opposing electrodes is covered by a solid dielectric material. More specifically, Yara discloses that at least one electrode is covered by a solid dielectric material (claim 1). Further, Yara specifically discloses that if at least one electrode is not covered with a solid dielectric material, an arc discharge is generated between the electrodes (paragraph [0016]). In contrast, amended claims 1 and 8 clearly recite that the opposing electrodes are not covered by a solid dielectric material. Mizuno also discloses that a portion of each electrode is covered by a ceramic insulator (dielectric material) (page 657). Hartmann and Awazu fail to overcome the deficiencies of Yara.

Further, Dr. Saito's Declaration shows that, when the surfaces of the electrodes are covered with a dielectric material (i.e., glass), an arc discharge was not observed, but also the diamond like carbon film was not formed on the substrate. Thus, use of the claimed opposing electrodes is distinct from the cited references.

Based on the above, the cited references fail to teach or suggest each and every element of amended claims 1 and 8. Accordingly, Applicants respectfully request that the Examiner reconsider and withdraw these rejections.

For at least the foregoing reasons, Applicants respectfully submit that all pending claims herein are on condition for allowance. Accordingly, the Examiner is requested to issue a Notice of Allowance for this application in due course.

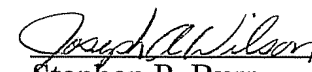
If the Examiner believes that contact with Applicants' attorney would be advantageous toward the disposition of this case, the Examiner is herein requested to call Applicants' attorney at the phone number noted below.

The Commissioner is hereby authorized to charge any additional fees associated with this communication or credit any overpayment to Deposit Account No. 50-1446.

Respectfully submitted,

April 1, 2010

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